

8. (a) Explain Birth-Death process with all possible cases.
- (b) The capacity of communication line is 2000 bits per second. The line is used to transmit eight bit characters. The application calls for traffic from many devices to be sent on the same line with a total volume of 12000 characters per minute. Determine the average number of characters waiting to be transmitted and average transmission time per character (including queueing delay). 10,10

Roll No.

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BT-7/DX

STATISTICAL MODELS FOR COMPUTER SCIENCE

Paper : CSE-405

Time : Three Hours]

[Maximum Marks : 100

Note : Attempt five questions in all, selecting at least one question from each unit.

UNIT-I

1. (a) Give the axiomatic definition of Probability and show that if $A \subseteq B$, then $P(A) \leq P(B)$.
- (b) A student wants to break into a computer file, which is password protected. Assume that there are n equally possible passwords and that the student chooses passwords independently and at random and tries them. Let N_n be the number of trials required for breaking the password. Find the probability function of N_n .
- (i) if unsuccessful passwords are not eliminated from further selections.
- (ii) if they are eliminated.
- (c) Explain Baye's theorem. 5,10,5
2. (a) For any two events A and B, show that $P(A \cap B) \leq P(A) \leq P(A \cup B) \leq P(A) + P(B)$.
- (b) If the events A and B are such that $P(A) \neq 0$, $P(B) \neq 0$ and A is independent of B then show that B is also independent of A.

- (c) In answering a question on a multiple choice test a student either knows the answer or he/she guesses. Let 0.4 be the probability that he knows the answer and 0.6 the probability that he guesses. Assume that a student who guesses an answer will be correct with probability 0.2, where 5 is the number of multiple-choice alternatives. What is the probability that a student knew the answer to a question given that he answered it correctly. 5,5,10

UNIT-II

3. (a) For joint probability density function

$$f(x, y) = \begin{cases} \frac{21}{4}x^2y & , \text{ if } x^2 \leq y < 1 \\ 0 & , \text{ otherwise} \end{cases}$$

- (i) Find marginal pdfs of x and y .
 (ii) Are x and y independent.

- (b) A random variable x may assume four values with probabilities :

$$\frac{(1+3x)}{4}, \frac{(1-x)}{4}, \frac{(1+2x)}{4} \text{ and } \frac{(1-4x)}{4} \text{ for what values (s) of } x, \text{ is this a probability function. } 10,10$$

4. (a) The radius of a sphere, say x is assumed to be continuous variable with pdf,

$$f(x) = \begin{cases} 6x(1-x) & , 0 < x < 1 \\ 0 & , \text{ otherwise} \end{cases}$$

Find the pdf of the volume V of the sphere.

- (b) Explain Geometric distribution. Derive variance and expectation of Geometric distribution. 10,10

UNIT-III

5. (a) Assuming that the number of arrivals, in the interval $(0, t]$ is poisson distributed with the parameters λt , compute the probability of an even number of arrivals. Also compute the probability of odd number of arrivals.
 (b) Explain Renewal process. Give any example of renewal process and explain it. 10,10
6. (a) What do you mean by Stochastic process. Explain classification of stochastic processes.
 (b) Compute the average working set size and average page fault rate in renewal model of program behaviour. 10,10

UNIT-IV

7. (a) A group of telephone subscribers is observed continuously during a 80-minute busy hour period. During this time they make 30 calls, with the total conversation time being 4200 seconds. Compute the call arrival rate and the traffic intensity.
 (b) Assume that a computer system is in one of three states. busy, idle or undergoing repair, respectively denoted by states 0, 1 and 2. Observing its states at 2 P.M. each day, we believe that the system approximately behaves like a homogeneous Markov chain with the transition probability matrix.

$$P = \begin{bmatrix} 0.6 & 0.2 & 0.2 \\ 0.1 & 0.8 & 0.1 \\ 0.6 & 0.0 & 0.4 \end{bmatrix}$$

Prove that the chain is irreducible, and determine the steady-state probabilities. 10,10